

1 What is claimed is:

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3 1. A system for modulating DS data on an I phase communicating
4 DI data and on a Q phase communicating DQ data, the I phase and Q
5 phase are phases of a modulated carrier signal communicating the
6 DI data and the DQ data and the DS data, the carrier signal has a
7 total phase equal to arctangent of the Q phase divided by the I
8 phase, the system comprising,

9 an encoder for encoding the DI data and the DQ data
10 respectively into an Io encoded signal and a Qo encoded signal,
11 an encoded subcarrier modulation signal generator for
12 receiving one or more of the DS data and the DI data and the DQ
13 data and for generating an encoded subcarrier modulation signal,
14 the encoded subcarrier modulation signal comprises a product of a
15 data partition function and the DS data, the data partition
16 function is a function of one or more of the DI data and the DQ
17 data and the DS data,

18 a modulator for modulating a subcarrier signal by the
19 encoded subcarrier modulation signal for providing a modulated
20 subcarrier signal, for modulating the total phase of the carrier
21 signal by the modulated subcarrier signal, for modulating the I
22 phase of the carrier signal by the Io encoded signal and by an I
23 phase subcarrier signal to provide an I phase carrier signal and
24 for modulating the Q phase of the carrier signal by the Qo
25 encoded signal and by a Q phase subcarrier signal to provide a Q
26 phase carrier signal, the modulator combining the Q phase carrier
27 signal and the I phase carrier signal as a composite signal, the
28 I phase subcarrier signal is an I intermodulation product of the

1 encoded subcarrier modulation signal and the Qo encoded signal,
2 the Q phase subcarrier signal is a Q intermodulation product of
3 the encoded subcarrier modulation signal and the Io encoded
4 signal, the ratio of the Q intermodulation product over the I
5 intermodulation product is equal to the ratio of the Io encoded
6 signal over the Qo encoded signal, the composite signal has a
7 constant amplitude envelop.

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1 2. The system of claim 1, wherein
2 the encoder comprises:
3 a Q encoder for encoding the DQ data into the Qo encoded
4 signal; and
5 an I encoder for encoding the DI data into the Io encoded
6 signal,
7 the encoded subcarrier modulation signal generator
8 comprises:
9 a data partition function generator for receiving one or
10 more of the DI data and the DQ data and the DS data and for
11 generating a data partition signal;
12 a modulo two mixer for mixing the data partition signal with
13 the DS data into a modified DS data signal; and
14 a data encoder encoding the modified DS data signal into the
15 encoded subcarrier modulation signal,
16 the modulator comprises:
17 a subcarrier generator for generating the subcarrier signal;
18 a multiplier for multiplying the subcarrier signal by a
19 modulation index for generating a scaled subcarrier signal;
20 a scaling mixer for mixing the scaled subcarrier signal with
21 the encoded subcarrier modulation signal for providing the
22 modulated subcarrier signal;
23 a sine and cosine subcarrier processor for receiving the
24 modulated subcarrier signal for generating a sine subcarrier
25 signal and a cosine subcarrier signal, the sine subcarrier signal
26 is modulated by the DS data, the cosine subcarrier signal is
27 unmodulated by the DS data;
28 a carrier phase rotator for combining the sine subcarrier

1 signal and the cosine subcarrier signal with both of Io encoded
2 signal and the Qo encoded signal and for providing I and Q
3 rotated signals, the I rotated signal comprises a scaled Io
4 encoded signal for communicating the DI data and comprises a
5 scaled I phase subcarrier signal for communicating the DS data,
6 the Q rotated signal comprises a scaled Qo encoded signal for
7 communicating the DQ data and a scaled Q phase subcarrier signal
8 for communicating the DS data, the scaled I phase and Q phase
9 subcarrier signals are the I and Q intermodulation products and
10 are generated when the sine and cosine subcarrier signals are
11 rotated and combined with Io encoded signal to form the I rotated
12 signal and when the sine and cosine subcarrier signals are
13 rotated and combined with the Qo encoded signal to form the Q
14 rotated signal, the scaled I phase and scaled Q phase subcarrier
15 signals are orthogonal and are the I and Q intermodulation
16 products of the Io and Qo encoded signals modulated by harmonics
17 of the modulated subcarrier signal, the I and Q rotated signals
18 are scaled by harmonics of the scaled subcarrier signal;
19 and,

20 a quadrature modulator for receiving the I and Q rotated
21 signals and the carrier signal for respective I and Q phase
22 modulation of the carrier signal by the I and Q rotated signals
23 to provide the composite signal having the I phase and Q phase,
24 the DI data is communicated on the I phase of the composite
25 signal, the DQ data is communicated on the Q phase of the
26 composite signal, and the DS data is communicated on both of the
27 I phase and Q phase of the composite signal, the constant
28 amplitude envelope results from the I and Q phase modulation of

1 the carrier signal by the modulated subcarrier signal.

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4 3. The system of claim 2, wherein the modulation index is less
5 than or equal to $\pi/2$ radians.

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8 4. The system of claim 1 wherein
9 the encoder comprises:

10 a Q encoder for encoding the Q data into the Qo encoded
11 signal; and

12 an I encoder for encoding the I data into the Io encoded
13 signal,

14 the encoded subcarrier modulation signal generator
15 comprises:

16 a data partition function generator for receiving one or
17 more of the DI data and the DQ data and the DS data for
18 generating a data partition signal;

19 a modulo two mixer for mixing the data partition signal with
20 the DS data into a modified DS data signal; and

21 a data encoder encoding the modified DS data signal into the
22 encoded subcarrier modulation signal,

23 the modulator comprises:

24 a subcarrier generator for generating the subcarrier signal;

25 a subcarrier modulator for modulating the encoded subcarrier
26 modulation signal onto the subcarrier signal to provide the
27 modulated subcarrier signal;

28 a quadrature modulator for modulating Io encoded signal and

1 Qo encoded signal onto an IF signal for providing a quadrature IF
2 signal;

3 a phase modulator having a modulation index for phase
4 modulating an RF signal by the modulated subcarrier signal to
5 provide a modulated subcarrier RF signal; and

6 a mixer for mixing the quadrature IF signal with the
7 modulated subcarrier RF signal to provide the composite signal
8 comprising the carrier signal that is a product of the IF signal
9 and the RF signal.

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11 5. The system of claim 4, wherein the subcarrier signal is a
12 sinewave signal.

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14 6. The system of claim 1, wherein,

15 the encoder is further for setting an I phase to Q phase
16 power ratio of power of the Io encoded signal relative to power
17 of the Qo encoded signal, and for further setting the same I
18 phase to Q phase power ratio of power of the Q phase subcarrier
19 signal relative to power of the I phase subcarrier signal, and
20 the modulator is defined by a modulation index for setting a
21 carrier to subcarrier power ratio between the power of Io and Qo
22 encoded signals relative to the I phase and Q phase subcarrier
23 signals.

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26 7. The system of claim 1, wherein the subcarrier signal is a
27 periodic signal.

1 8. A system for modulating DS data on an I phase communicating
2 DI data and on a Q phase communicating DQ data, the I phase and Q
3 phase are phases of a modulated carrier signal communicating the
4 DI data and DQ data, the carrier signal has a total phase equal
5 to arctangent of the Q phase divided by the I phase, the DI data
6 is communicated in spread spectrum signals spread by an CI code,
7 the DQ data is communicated in spread spectrum signals spread by
8 an CQ code, the DS data is communicated in spread spectrum
9 signals spread by an CS code, the DS data is subcarrier data and
10 CS code is a subcarrier code, the system comprising,
11 an encoder for encoding the DI data spread by the CI code
12 into an Io encoded signal, and for encoding the DQ data spread by
13 the CQ code into a Qo encoded signal,
14 an encoded subcarrier modulation signal generator for
15 receiving the DS data and the CS code and the DI data and the CI
16 code and the DQ data and the CQ code and for generating an
17 encoded subcarrier modulation signal, the encoded subcarrier
18 modulation signal comprises a product of a data partition
19 function and a code partition function and the DS data and the CS
20 code, the data partition function is a function of one or more of
21 the DI data and the QI data and the DS data, the code partition
22 function is a function of one or more of the CI code and the CQ
23 code and the CS code, and
24 a modulator for modulating a subcarrier signal by the
25 encoded subcarrier modulation signal for providing a modulated
26 subcarrier signal, for modulating the total phase of the carrier
27 signal by the modulated subcarrier signal, for modulating the I
28 phase of the carrier signal by the Io encoded signal and by an I

1 phase subcarrier signal to provide an I phase carrier signal and
2 for modulating the Q phase of the carrier signal by the Qo
3 encoded signal and by an Q phase subcarrier signal to provide a Q
4 phase carrier signal, the carrier modulator combining the Q phase
5 carrier signal and the I phase carrier signal as a composite
6 signal, the Q phase subcarrier signal is a Q intermodulation
7 product of the encoded subcarrier modulation signal and the Io
8 encoded signal, the I phase subcarrier signal is an I
9 intermodulation product of the encoded subcarrier modulation
10 signal and the Qo encoded signal, the ratio of the Q
11 intermodulation product over the I intermodulation product is
12 equal to the ratio of the Io encoded signal over the Qo encoded
13 signal, the composite signal has a constant amplitude envelop.

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1 9. The system of claim 8, wherein,
2 the data partition function is an alpha function, the alpha
3 function has a square identity, the alpha function is selected
4 from a group consisting of a first alpha function equaling DI
5 that equals DQ, a second alpha function equaling DS when DI equal
6 to DQ, a third alpha function equaling DS when DI does not equal
7 DQ, a fourth alpha function equaling one when DI does not equal
8 DQ, and a fifth alpha function equaling one when DI equals DQ,
9 and

10 the code partition function is a beta function, the beta
11 function has a square identity, the beta function is selected
12 from a group consisting of a first beta function equaling one, a
13 second beta function equaling CI times CQ, a third beta function
14 equaling CI, a fourth beta function equaling CQ, and a fifth beta
15 function equaling CS.

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17 10. The system of claim 8, wherein the encoder is further for
18 setting a power ratio of the I_o encoded signal relative to Q_o
19 encoded signals, and for setting the same power ratio of the Q
20 phase subcarrier signal relative to the I phase subcarrier
21 signal.

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24 11. The system of claim 8, wherein the modulator is defined by a
25 modulation index for setting a power ratio between power of I_o
26 and Q_o encoded signals relative to power of the Q phase and I
27 phase subcarrier signals.

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1 12. The system of claim 11, wherein power of the Q phase and I
2 phase subcarrier signals is less than power of the Io and Qo
3 encoded signals modulated on the carrier signal.

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5 13. The system of claim 8, wherein the modulator comprises,
6 a subcarrier generator for generating the subcarrier signal;
7 a subcarrier modulator for modulating the encoded subcarrier
8 modulation signal onto the subcarrier signal to provide a
9 modulated subcarrier signal;
10 a quadrature modulator for modulating Io encoded signal and
11 Qo encoded signal onto an IF signal for providing a quadrature IF
12 signal;
13 a phase modulator having a modulation index for phase
14 modulating an RF signal by the modulated subcarrier signal to
15 provide a modulated subcarrier RF signal; and
16 a mixer for mixing the quadrature IF signal with the
17 modulated subcarrier RF signal to provide the composite signal
18 comprising the carrier signal that is a product of the IF signal
19 and the RF signal.

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21 14. The system of claim 8, wherein the encoder comprises,
22 a Q mixer for spreading the DQ data by the CQ code to
23 provide a DCQ spread spectrum signal,
24 a Q encoder for encoding the DCQ spread spectrum signal into
25 the Qo encoded signal,
26 a Q amplifier for setting a Q power level of the Qo encoded
27 signal,
28 an I mixer for spreading the DI data by the CI code to

1 provide a DCI spread spectrum signal,
2 an I encoder for encoding the DCI spread spectrum signal
3 into the Io encoded signal, and
4 an I amplifier for setting an I power level of the Io
5 encoded signal.

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8 15. The system of claim 14, wherein the I power level does not
9 equal the Q power level.

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12 16. The system of claim 8, wherein the encoded subcarrier
13 modulation signal generator comprises,
14 a data partition function generator for receiving one or
15 more of the DS data and the DI data and the DQ data and for
16 generating a data partition signal,
17 a code partition function generator for receiving one or
18 more of the CS code and the CI code and the QI code and for
19 generating a code partition signal,
20 a data mixer for modulo two mixing the DS data and the data
21 partition signal into a modulo two data signal,
22 a code mixer for modulo two mixing the CS code and the code
23 partition signal into a modulo two code signal,
24 a modulo two mixer for modulo two mixing the modulo two data
25 signal with the modulo two code signal for providing a modified
26 subcarrier data signal, and
27 a data encoder for encoding the modified subcarrier data
28 signal into the encoded subcarrier modulation signal.

1 17. The system of claim 8, wherein the modulator comprises,
2 a subcarrier generator for generating the subcarrier signal;
3 a multiplier for multiplying the subcarrier signal by a
4 modulation index for generating a scaled subcarrier signal;
5 a scaling mixer for mixing the scaled subcarrier signal with
6 the encoded subcarrier modulation signal for providing a
7 modulated subcarrier signal;
8 a sine and cosine subcarrier processor for receiving the
9 modulated subcarrier signal for generating a sine subcarrier
10 signal and a cosine subcarrier signal, the sine subcarrier signal
11 is modulated by the DS data, the cosine subcarrier signal is
12 unmodulated by the DS data;
13 a carrier phase rotator for combining the sine subcarrier
14 signal and the cosine subcarrier signal with both of Io encoded
15 signal and the Qo encoded signal and for providing I and Q
16 rotated signals, the I rotated signal comprises a scaled Io
17 encoded signal for communicating the DI data and comprises a
18 scaled I phase subcarrier signal for communicating the DS data,
19 the Q rotated signal comprises a scaled Qo encoded signal for
20 communicating the DQ data and a scaled Q phase subcarrier signal
21 for communicating the DS data, the scaled I phase and Q phase
22 subcarrier signals are the I and Q intermodulation products and
23 are generated when the sine and cosine subcarrier signals are
24 rotated and combined with Io encoded signal to form the I rotated
25 signal and when the sine and cosine subcarrier signals are
26 rotated and combined with the Qo encoded signal to form the Q
27 rotated signal, the scaled I phase and scaled Q phase subcarrier
28 signals are orthogonal and are the I and Q intermodulation

1 products of the I_o and Q_o encoded signals modulated by harmonics
2 of the modulated subcarrier signal, the I and Q rotated signals
3 are scaled by harmonics of the scaled subcarrier signal; and
4 a quadrature modulator for receiving the I and Q rotated
5 signals and the carrier signal for respective I and Q phase
6 modulation of the carrier signal by the I and Q rotated signals
7 to provide the composite signal having the I phase and Q phase,
8 the DI data is communicated on the I phase of the composite
9 signal, the DQ data is communicated on the Q phase of the
10 composite signal, and the DS data is communicated on both of the
11 I phase and Q phase of the composite signal, the constant
12 amplitude envelope results from the I and Q phase modulation of
13 the carrier signal by the modulated subcarrier signal.

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16 18. The system of the claim 17, wherein the subcarrier signal is
17 a squarewave.

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20 19. The system of claim 8, wherein the modulator comprises,
21 a subcarrier generator for generating the subcarrier signal;
22 a multiplier for multiplying the subcarrier signal by a
23 modulation index for generating a scaled subcarrier signal;
24 a scaling mixer for mixing the scaled subcarrier signal with
25 the encoded subcarrier modulation signal for providing a
26 modulated subcarrier signal;
27 a sine and cosine subcarrier processor for receiving the
28 modulated subcarrier signal for generating a sine subcarrier

1 signal and a cosine subcarrier signal, the sine subcarrier signal
2 is modulated by the DS data, the cosine subcarrier signal is
3 unmodulated by the DS data;

4 a carrier phase rotator for combining the sine subcarrier
5 signal and the cosine subcarrier signal with both of Io encoded
6 signal and the Qo encoded signal and for providing I and Q
7 rotated signals, the I rotated signal comprises a scaled Io
8 encoded signal for communicating the DI data and comprises a
9 scaled I phase subcarrier signal for communicating the DS data,
10 the Q rotated signal comprises a scaled Qo encoded signal for
11 communicating the DQ data and a scaled Q phase subcarrier signal
12 for communicating the DS data, the scaled I phase and Q phase
13 subcarrier signals are the I and Q intermodulation products and
14 are generated when the sine and cosine subcarrier signals are
15 rotated and combined with Io encoded signal to form the I rotated
16 signal and when the sine and cosine subcarrier signals are
17 rotated and combined with the Qo encoded signal to form the Q
18 rotated signal, the scaled I phase and scaled Q phase subcarrier
19 signals are orthogonal and are the I and Q intermodulation
20 products of the Io and Qo encoded signals modulated by harmonics
21 of the modulated subcarrier signal, the I and Q rotated signals
22 are scaled by harmonics of the scaled subcarrier signal, the sine
23 subcarrier signal comprises modulation index scaled, subcarrier
24 data modulated, odd subcarrier harmonic signals, the cosine
25 subcarrier signal comprises modulation index scaled even
26 subcarrier harmonic signals, the modulation index is set to a
27 predetermined value to weight subcarrier harmonics to set power
28 of the carrier signal relative to the subcarrier signal while

1 maintaining the constant envelop of the composite signal; and
2 a quadrature modulator for receiving the I and Q rotated
3 signals and the carrier signal for respective I and Q phase
4 modulation of the carrier signal by the I and Q rotated signals
5 to provide the composite signal having the I phase and Q phase,
6 the DI data is communicated on the I phase of the composite
7 signal, the DQ data is communicated on the Q phase of the
8 composite signal, and the DS data is communicated on both of the
9 I phase and Q phase of the composite signal, the constant
10 amplitude envelope results from the I and Q phase modulation of
11 the carrier signal by the modulated subcarrier signal.

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14 20. The system of claim 19, wherein the modulated subcarrier
15 signal is equal to the modulation index multiplied by the DS data
16 by the data partition function by the code partition function by
17 CS code and by the subcarrier signal.

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